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ABSTRACT

This fact sheet details important information on Indoor Air Quality (IAQ) in school buildings, problems associated with IAQ, and various prevention and problem-solving strategies. Most people spend 90 percent of their time indoors, therefore the Environmental Protection Agency ranks IAQ in the top four environmental risks to the public. The consequences surrounding poor IAQ affect not only the health and productivity of students and staff but also the physical school plant. Four factors affecting IAQ are: sources of indoor pollutants; the heating, ventilation, and air conditioning systems (HVAC); pollutant pathways; and the building occupants. Six basic control strategies for lowering concentrations of indoor air pollutants include (1) removing, substituting, and encapsulating the source; (2) the effective use of local exhaust; (3) ventilation to dilute contaminated air; (4) exposure control using the principles of time and location use; (5) cleaning the air by filtration; and (6) education to help reduce personal exposure. Diagnosing indoor air quality problems involves identifying short-term symptoms typically associated with colds, flu, and allergies. Long-term symptoms such as cancer are more difficult to identify. Preventive indoor air programs need to be established to minimize students and staff exposure to pollutants. This fact sheet makes reference to an "EPA Indoor Air Quality Tools for Schools Kit" (which includes a checklist, guide, problem-solving wheel, fact sheet, sample memo, and sample policies) and recommends obtaining the kit in the event symptoms of indoor air pollutants related to the school environment are experienced. (RE)

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Indoor Air Quality Basics for Schools

This fact sheet provides important information on indoor air quality (IAQ) in schools to parents and others who do not normally occupy school buildings. Once you understand the basics that influence indoor air quality in a school, you will note that prevention and problem solving mainly involve two major actions — the management of pollutant sources, and the use of ventilation to control pollutants. Following are the key principles:

- Many IAQ problems can be prevented by school staff and students
- When IAQ problems happen, they can often be resolved using the skills of school staff
- The expense and effort required to prevent most IAQ problems is much less than the expense and effort required to solve problems after they develop

Why IAQ is Important to Your School

Most people are aware that outdoor air pollution can damage their health, but many do not know that indoor air pollution can also cause harm. Environmental Protection Agency (EPA) studies of human exposure to air pollutants indicate that indoor levels of pollutants may be 2-5 times, and occasionally more than 100 times, higher than outdoor levels. These levels of indoor air pollutants are of particular concern because it is estimated that most people spend about 90% of their time indoors. Comparative risk studies performed by EPA and its Science Advisory Board have consistently ranked indoor air pollution among the top four environmental risks to the public.

Failure to prevent indoor air problems, or failure to act promptly, can have consequences such as:

- increasing the chances for long-term and short-term health problems for students and staff
- impacting the student learning environment, comfort, and attendance
- reducing productivity of teachers and staff due to discomfort, sickness, or absenteeism
- faster deterioration and reduced efficiency of the school physical plant and equipment
- increasing the chance that schools will have to be closed, or occupants temporarily moved
- straining relationships among school administration and parents and staff
- creating negative publicity that could damage a school's or administration's image and effectiveness
- creating potential liability problems

Indoor air problems can be subtle and do not always produce easily recognized impacts on health, well-being, or the physical plant. Children are especially susceptible to air pollution. For this and the reasons noted above, air quality in schools is of particular concern. Proper maintenance of indoor air is more than a "quality" issue, it includes safety and good management of our investment in the students, staff, and facilities.

Good indoor air quality contributes to a favorable learning environment for students, productivity for teachers and staff, and a sense of comfort, health, and well-being for school occupants. These combine to assist a school in its core mission — educating children.

Understanding IAQ Problems and Solutions

Over the past forty or fifty years, exposure to indoor air pollutants has increased due to a variety of factors, including the construction of more tightly sealed buildings, reduced ventilation rates to save energy, the use of synthetic building materials and furnishings, and the use of chemically-formulated personal care products, pesticides, and housekeeping supplies. In addition, our activities and decisions, such as delaying maintenance to "save" money, can lead to problems from sources and ventilation. Four basic factors affect IAQ: sources of indoor air pollutants, the heating, ventilation, and air-conditioning (HVAC) system, pollutant pathways, and occupants.

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Sources of Indoor Air Pollutants

Indoor air contaminants can begin within the building or be drawn in from outdoors. If pollutant sources are not controlled, IAQ problems can occur, even if the HVAC system is working properly. Air pollutants consist of numerous particles, fibers, mists, molds, bacteria, and gases. It may be helpful to think of air pollutant sources as fitting into one of the categories in the table shown below.

In addition to the number of potential pollutants, indoor air pollutant levels can vary within the school building, or even a single classroom. Pollutants can also vary with time, such as only once each week when floor stripping is done, or continuously such as when fungi is growing in the HVAC system.

HVAC System Design and Operation

The heating, ventilation, and air-conditioning (HVAC) system includes all heating, cooling, and ventilating equipment serving a school. A properly designed and functioning HVAC system:

- controls temperature and humidity to provide thermal comfort
- distributes adequate amounts of outdoor air to meet ventilation needs of school occupants
- isolates and removes odors and pollutants through pressure control, filtration, and exhaust fans

Not all HVAC systems are designed to do all of these things. Some buildings rely only on natural ventilation. Others lack cooling, and many have little or no humidity control.

Pollutant Pathways and Driving Forces

Airflow patterns in buildings are caused by mechanical ventilation systems, human activity, and natural effects such as wind. Air pressure differences created by these forces move airborne pollutants from areas of higher pressure to areas of lower pressure through any available openings in building walls, ceilings, floors, doors, windows, and HVAC system. An inflated balloon is an example of this driving force. As long as the opening to the balloon is kept shut, no air will flow, but when open, air will move from inside (area of higher pressure) to the outside (area of lower pressure). Even if the opening is small, air will move until the pressures inside and outside are equal.

Typical Sources of Indoor Air Pollutants

Outside Sources

Polluted Outdoor Air

- pollen, dust, fungal spores
- industrial emissions
- vehicle emissions

Nearby Sources

- loading docks
- odors from dumpsters
- unsanitary debris or building exhausts near outdoor air intakes

Underground Sources

- radon
- pesticides
- leakage from underground storage tanks

Building Equipment

HVAC Equipment

- microbiological growth in drip pans, ductwork, coils, and humidifiers
- improper venting of combustion products
- dust or debris in ductwork

Non-HVAC Equipment

- emissions from office equipment (volatile organic compounds, ozone)
- emissions from shops, labs, cleaning processes

Components/Furnishings

Components

- microbiological growth on soiled or water-damaged materials
- dry traps that allow the passage of sewer gas
- materials containing volatile organic compounds, inorganic compounds, or damaged asbestos
- materials that produce particles (dust)

Furnishings

- emissions from new furnishings and floorings
- microbiological growth on or in soiled or water-damaged furnishings

Other Indoor Sources

- science laboratories
- vocational arts areas
- copy/print areas
- food preparation areas
- smoking lounges
- cleaning materials
- emissions from trash
- pesticides
- odors and volatile organic compounds from paint, caulk, adhesives
- occupants with communicable diseases
- dry-erase markers and similar pens
- insects & other pests
- personal care products

Building Occupants and Health

Building occupants in schools include the staff, students, and other people who spend extended periods of time in the school. The effects of IAQ problems on occupants are often vague symptoms rather than clearly defined illnesses. Symptoms commonly attributed to IAQ problems include:

- headache, fatigue, and shortness of breath
- sinus congestion, cough, and sneezing
- eye, nose, throat, and skin irritation
- dizziness and nausea

All of these symptoms, however, may also be caused by other factors, and are not necessarily due to air quality problems. Environmental stressors such as improper lighting, noise, vibration, overcrowding, and psychosocial problems (such as job or home stress) can produce symptoms that are similar to those associated with poor air quality, but require different solutions.

Because people are different, one individual may react to a particular IAQ problem while surrounding occupants have no noticeable ill effects. In other cases, complaints may be widespread. In addition to different degrees of reaction, an indoor air pollutant or problem can trigger different types of reactions in different people. Some groups that may be particularly susceptible to effects of indoor air contaminants include:

- allergic or asthmatic individuals, or people with sensitivity to chemicals
- people with respiratory disease
- people whose immune systems are suppressed due to radiation or chemotherapy, or disease
- contact lens wearers

Six Basic Control Strategies

There are six basic methods for lowering concentrations of indoor air pollutants. Specific applications of these methods are noted in the *Indoor Air Quality Tools for Schools* Kit (see the back page for information on the Kit).

Source Management includes source removal, source substitution, and source encapsulation. Source management is the most effective control method when it can be practically applied. The best prevention method is never to bring unnecessary pollutants into the school building. Examples of source removal include not allowing buses to idle near outdoor air intakes, not placing garbage in rooms where HVAC equipment is located, and banning smoking within the school. Source substitution includes actions such as selecting less toxic art material or interior paint than the products which are currently in use. Source encapsulation involves placing a barrier around the source so that it releases fewer pollutants into the indoor air.

Local Exhaust is very effective in removing sources of pollutants before they can be dispersed into the indoor air, exhausting the contaminated air outside. Well known examples include restrooms, kitchens, and science lab fume hoods. Other examples of pollutants that originate at specific points and that can be easily exhausted include science lab and housekeeping storage rooms, printing and duplicating rooms, and vocational/industrial areas such as welding booths.

Ventilation uses cleaner (i.e., outdoor) air to dilute the contaminated (i.e., indoor) air that people are breathing. Generally, local building codes specify the amount of outdoor air that must be continuously supplied to an occupied area. For situations such as painting, pesticide application, or chemical spills, temporarily increasing the ventilation can be useful in diluting the concentration of fumes in the air.

Exposure Control includes the principles of time of use and location of use. An example of time of use would be to strip and wax floors on Friday after school is dismissed, so that the floor products have a chance to release gases over the weekend, reducing the level of odors or contaminants in the air when the school is occupied. An example of location of use involves moving the contaminating source as far as possible from occupants, or relocating susceptible occupants.

Air Cleaning primarily involves the filtration of particles from the air as the air passes through the ventilation equipment. Gaseous contaminants can also be removed, but usually this type of system should be engineered on a case-by-case basis.

Education of the school occupants is critical. If school staff are provided information about the sources and effects of contaminants under their control, and about the proper operation of the ventilation system, they will better understand their indoor environment and can act to reduce their personal exposure.

How Do I Know if There is an IAQ Problem

Diagnosing symptoms that relate to IAQ can be tricky. Acute (short-term) symptoms of IAQ problems typically are similar to those from colds, allergies, fatigue, or the flu. There are clues, however, that can serve as indicators of potential indoor air problems:

- the symptoms are widespread within a class or within the school, potentially indicating a ventilation problem
- the symptoms disappear when the students or staff leave the school building for the day
- the onset is sudden after some change at school, such as painting or pesticide application
- persons with allergies, asthma, or chemical sensitivities have reactions indoors but not outdoors
- a doctor has diagnosed a student or staff member as having an indoor air-related illness

However, a lack of symptoms does not mean that the quality of the air within the school is acceptable. Symptoms from long-term health effects (such as lung cancer due to radon) often do not become evident for many years. For this reason, schools should establish a preventive indoor air program to minimize exposure of students and staff to indoor air pollutants (see information on the "Kit," next section).

What Should I Do if I Think a School has an IAQ Problem

If your child, or someone else you know, is experiencing symptoms that you believe may be related to their school environment, contact a school official immediately, such as the school IAQ Coordinator, or the health and safety coordinator. Whether or not the school has a known problem, encourage the school to obtain and use the *Indoor Air Quality Tools for Schools* Kit. This easy-to-use Kit shows schools how to carry out a practical plan of action at little or no cost, using in-house staff.

The Kit includes simple checklists for all school employees, a flexible step-by-step guide for using the checklists, an Indoor Air Quality Problem Solving Wheel, a fact sheet on indoor air pollution sources and solutions, sample memos to help school personnel respond to inquiries, and sample policies.

What You Can Do

1. Read this fact sheet
2. Ensure that your school gets the *Indoor Air Quality Tools for Schools* Kit
3. Ensure that your school uses the Kit

The Kit is co-sponsored by the National PTA, National Education Association, Council for American Private Education, Association of School Business Officials, American Federation of Teachers, and the American Lung Association.

The Federal government, as well as most State and local governments, do not have regulations or enforcement capabilities regarding indoor air quality in schools. For some schools, assistance may be available from the local or State departments of health or environment. The Federal or State occupational safety and health office (OSHA) may also provide some help.

How to Order the Kit

The *Indoor Air Quality Tools for Schools* Kit, item number 055-000-00503-6, can be purchased for $22 from the U.S. Government Printing Office. MasterCard and Visa are accepted. For telephone orders, call 202-512-1800. Or send a check or money order to:

Superintendent of Documents
PO Box 371954, Pittsburgh, PA 15250.

While supplies last, school districts and schools may receive a free copy of the *IAQ Tools for Schools* Kit by having a school administrator mail or fax a request on official school letterhead to:

EPA Kit
PO Box 37133
Washington, DC 20013-7133
Fax: 202-484-1510

Other information on IAQ is available by contacting your Regional EPA office, or by calling 800-438-4318.